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Rubber and plastics hoses and hose assemblies — Guide to selection, storage, use and maintenance

*Tuyaux et flexibles en caoutchouc et en plastique — Guide technique
pour la sélection, le stockage, l'utilisation et la maintenance*



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 8331 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Sub-Committee SC 1, *Hoses (rubber and plastics)*.

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Rubber and plastics hoses and hose assemblies — Guide to selection, storage, use and maintenance

Section 1: General

1.1 Scope

This International Standard sets out recommendations designed to maintain rubber and plastics hoses and hose assemblies, prior to use, in a condition as close as possible to their condition upon receipt and to obtain the maximum service life under normal operating conditions.

NOTE 1 This International Standard should be read in conjunction with any applicable national statutory regulations.

1.2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions

of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 1402:1984, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*.

ISO 8031:1987, *Rubber and plastics hoses and hose assemblies — Determination of electrical resistance*.

Section 2: General recommendations

2.1 Selection criteria

It is in the best interests of the user to select hoses or hose assemblies which comply with national or international standards whenever they exist for the intended application.

If there are difficulties in interpretation of suitability, if there are any special requirements or if the necessary information is not available, a hose manufacturer or trade association should be consulted.

The following points should be taken into consideration when selecting a hose or hose assembly for a specific application:

a) Operational environment:

- ambient temperature
- atmospheric conditions
- contact with deleterious media

b) Media conveyed:

- liquid
- gaseous
- solids
- combinations of the above

c) Method of conveyance:

- pressure (including rate of flow)
- suction (including rate of flow)
- gravity (including rate of flow)
- assisted (mixture of solid/fluid, solid/air)

d) Operating conditions:

- pressure and temperature of product conveyed
- frequency of use

e) Installation:

- degree of curvature
- vibration of system

- risk of damage by impact and abrasion

- use of correct type of connection

2.2 Storage conditions

2.2.1 General

During storage, especially long periods, and when they are exposed to certain factors, the physical properties of hoses and hose assemblies undergo changes that may result in them no longer having the optimum characteristics corresponding to their application when they are put into service. The storage conditions should be such as will offer maximum protection and minimize deterioration of the articles during storage.

2.2.2 Storage period

The storage period should be kept to a minimum. Rotation of stock is therefore essential and the "first-in first-out" rule applied. If long-term storage, defined as 2 years maximum for hose assemblies and 4 years maximum for bulk hose, cannot be avoided, the article should be inspected and/or tested prior to use.

2.2.3 Temperature

The storage temperature should, whenever possible, be between 0 °C and 35 °C, preferably around 15 °C. Articles should not be subjected to temperatures over 50 °C or below -30 °C nor to abnormal fluctuations in temperature during the storage period.

2.2.4 Humidity

The relative humidity should preferably not exceed 65 %.

2.2.5 Light

The articles should be stored in a dark place away from sunlight and strong artificial light. If the storage area has windows or glazed openings, they should be obscured with red, orange or white coverings.

2.2.6 Ozone

Because of the harmful effect of ozone on rubber-based articles, storage areas should not contain equipment capable of generating ozone, for example mercury vapour lamps or tubes, high-voltage electrical equipment, electric motors or other

equipment likely to cause sparks or electrical discharges.

2.2.7 Environment

Articles should not be placed in contact with certain products or exposed to their vapours, particularly solvents, oils, greases, acids, disinfectants, etc. Some metals, such as copper, iron and manganese, have a harmful effect on certain rubber compounds.

2.2.8 Source of heat

Articles should not be stored in close proximity to heat sources. The distance between them should be sufficient to ensure compliance with the recommendations of 2.2.3.

2.2.9 Electric and magnetic fields

Storage areas should not be in the vicinity of equipment that may generate electric or magnetic fields as variations/fluctuations in the fields could induce currents in metallic joints which, in turn, generate heat.

2.2.10 Method of storing

Articles should be stored in such a way that they are not subjected to excessive stress, elongation or deformation. Contact with sharp, pointed or abrasive objects or surfaces should be avoided and storage racks should be provided whenever possible.

Coiled hose or hose assemblies should be stored flat and preferably not stacked. When stacking is unavoidable, the height of the stacks should be restricted so that the articles at the bottom do not suffer permanent deformation. The hanging of coils on pegs is not recommended.

Hoses and hose assemblies supplied in straight lengths should be stored flat and without bending.

End caps should be maintained on hoses supplied with them.

2.2.11 Rodents

Articles should be secure from attack by rodents and adequate protection should be provided if there are any risks.

2.2.12 Issue from storage

Care should be taken to ensure that articles issued from stock are in their correct condition and correspond to their intended application. Identification of the different types in stock is essential.

Hose assemblies which do not have permanent end fittings, i.e. those with clipping/clamping arrangements that can be adjusted, should be checked to ensure that the end fittings are secure.

2.2.13 Return to storage

Before being returned to storage, articles which have been withdrawn from service should be drained of the substance they have been used to convey. Special care should be exercised with hoses that have been used to transport chemical, explosive, flammable or corrosive products. After cleaning and before return to storage, the articles should be examined to establish their suitability for continued use.

2.3 Use and maintenance

2.3.1 Handling

Hoses and hose assemblies should always be handled with care. They should not be dragged over sharp or abrasive surfaces. They should not be subjected to kinking or flattening, for example run over by vehicles.

2.3.2 Pressure

Articles should not be subjected to pressures, including surge pressures, in excess of the specified design working pressure.

2.3.3 Temperature

Articles should not be used at temperatures, both product conveyed temperature and environment temperature, outside the range specified or recommended by the manufacturer.

2.3.4 Products conveyed

Hoses and hose assemblies should only be used for conveying the products for which they are designed. If there is doubt regarding the suitability, the manufacturer should be consulted. When potentially dangerous products, for example toxic, corrosive, explosive or flammable, are being conveyed, precautions to minimize the effects of spillage due to leakage should be taken and it is recommended that, when not in use, hoses and hose assemblies should not remain filled.

2.3.5 Environment

Hoses and hose assemblies should not be used in environments other than those for which they were designed. If there is doubt regarding the suitability of the environment, or if unusual or variable condi-

tions are experienced, the manufacturer should be consulted.

2.3.6 Bending radii

Hoses and hose assemblies should not be used with bends less than the minimum bend radius specified or recommended by the manufacturer as this may restrict the passage of the product being conveyed or damage the hose assembly. Bends or kinking adjacent to end fittings should be avoided as continued bending in the same area may fatigue the reinforcement and lead to premature failure.

2.3.7 Torsional stress

Generally hoses and hose assemblies are not designed to operate in torsion. Installation should be such that relative motion of machine components produces bending of the hose and eliminates twisting.

2.3.8 Tensile stress

Only when they are specially designed to do so should hoses and hose assemblies be subjected to tensile stress. If there is doubt regarding the suitability, the manufacturer should be consulted.

2.3.9 Vibration

Vibration subjects hoses and hose assemblies to fatigue and heating, particularly around the connections, which can lead to premature failure. It should be ascertained from the manufacturer that a hose is designed to withstand vibration.

2.3.10 Assembly of end fittings

Before proceeding with the assembly, the compatibility of the fitting, the hose and the method of securement should be ascertained. In case of doubt, the manufacturers of the hose and the end fitting should be consulted.

Fittings should be free from sharp edges and the dimensions of tail pieces, ferrules, etc., should be such as to ensure an effective seal when correctly fitted. Swaging pressures and clip torque loads should be controlled, as insufficient or excessive pressures/loadings will lead to premature failure of the assembly. To facilitate ease of insertion of the fitting into the hose, the use of plain or soapy water is recommended. Products containing oil, grease or solvents should not be used unless the hose is specifically designed to convey them. Care should be taken not to subject the hose to torsional stress when inserting the fitting.

2.3.11 Leaktightness

After the attachment of the end fittings, it is recommended that the assembly be hydrostatically tested, to the specified test pressure of the hose, to establish the effectiveness of the joint, i.e. freedom from leaks and no evidence of slipping between the fitting and the hose. In the absence of statutory regulations or other standards, it is recommended that the hydrostatic test be carried out in accordance with ISO 1402.

2.3.12 Electrical properties

When there are requirements regarding electrical properties of the hose or hose assembly, it is recommended that they be ascertained in accordance with ISO 8031. Continued compliance should be established by retesting at regular intervals.

2.3.13 Fixed installations

Hoses and hose assemblies used in fixed installations should, whenever possible, be supported by adequate clipping. Care should be taken to ensure that the normal movement of the hose under pressure/suction, i.e. dilation, change in length and twist, are not restricted by the clipping arrangement.

2.3.14 Moving parts

When the hose or hose assembly is used as a couplant between moving parts or components, it should be ensured that the length is adequate without being excessive and that any movement does not result in the hose being subjected to shock loadings, pinching, abrasion, excessive bending or tensile/torsional stress.

2.3.15 Marking/identification

If marking additional to that specified in the hose standard or further identification is required, it is recommended that this be done by the application of adhesive tape bearing the required marking. Marking directly on to the hose is not recommended as the hose cover compound may not be compatible with the solvents used in the manufacture of paints and inks.

2.3.16 Maintenance

Hose and hose assemblies, excluding those for which there are regulations, standards or contractual requirements, should be subjected to periodic testing/inspection to establish their suitability for continued use. Particularly attention should be paid to the condition of the connections and adjacent areas and for the appearance of defects indicative of deterioration of the hose due either to normal ageing or to damage attributable to abnormal ser-

vice conditions, maltreatment or accident during use.

The following defects are sufficient justification for the withdrawal of hose from service:

- punctures, splits, tears, exposure of reinforcement;
- ozone cracking;
- localized deformation, blisters, swelling under pressure;

- soft or sticky patches.

When "use-by" or expiry dates are included in the hose marking, they should be observed even if the hose shows no apparent signs of deterioration.

2.3.17 Repairing of hoses

Hose repair is not recommended unless specifically addressed by the manufacturer. If repair of hose is permitted, the manufacturer's instructions should be followed carefully.

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Section 3: Additional recommendations for specific applications

NOTE 2 The following recommendations supplement the general recommendations given in section 2.

3.1 Welding and gas-cutting hose

The gases used for these applications are oxygen, acetylene, liquefied petroleum gases (LPG) and non-combustible inert gases, for example argon, nitrogen, etc., and the linings of the hoses are compounded to avoid reaction with the particular gas they convey. To avoid confusion and to ensure that the correct hose is used, the covers of the hoses are coloured as follows:

blue or green: for oxygen

red: for acetylene

orange: for LPG

black: for non-combustible inert gases

Under no circumstances should these hoses be used for any other purpose nor for the conveyance of a gas other than that for which they are identified.

NOTE 3 Hoses for welding and gas-cutting applications intended to convey LPG, i.e. with an orange cover, are not suitable for connecting household appliances using propane/butane.

3.2 Steam hose

Unless otherwise stipulated or specified, steam hoses are designed to convey saturated steam for which there is a direct relationship between temperature and pressure. Hoses required to convey superheated steam, for which there is no direct relationship between temperature and pressure, are subject to different stresses and the hose manufacturer should be consulted.

When steam hose is not in continuous use or if there are cooling phases in the service cycle, the hose is subjected to thermal shock which can result in popping and the hose should be examined at relatively short intervals to establish its suitability for further use.

In view of the serious consequences of failure, i.e. injury by scalding, adequate precautions should be taken to protect personnel and to minimize the effects of bursting of the hose or hose assembly.

3.3 Hoses for the conveyance of foodstuffs

Hoses and hose assemblies for this application are generally subject to statutory health regulations. Consequently, hoses are manufactured with linings compounded to avoid reaction with the products to be conveyed which could result in contamination. Hoses and hose assemblies should therefore only be used to convey the product for which they were designed and any regulations regarding cleaning materials, procedures and frequency should be strictly adhered to.

3.4 Hoses for the conveyance of abrasive products

In order to obtain maximum service life, hoses and hose assemblies used for the conveyance of abrasive products should be used, wherever possible, in a straight position. When the inclusion of bends cannot be avoided, bend radii as large as possible should be used. Installations incorporating small bends or coiled hose will inevitably result in rapid localized wear of the lining, caused by turbulence, and premature failure.

To minimize wear by abrasion, it is recommended that couplings should be by external fittings as the absence of nipples/tail-pieces inserted into the hose reduces the possibility of turbulence.

The electrical continuity required of this type of hose assembly should be periodically checked to ensure the effective discharge of static electricity generated by the friction of the particles conveyed against the wall of the hose. If the static electricity is not discharged, the hoses may fail prematurely due to perforations caused by electric flashes.

3.5 Hoses for the conveyance of corrosive or aggressive products

Agro-pharmaceutical products, acids and some chemical products are designated corrosive or aggressive and hoses or hose assemblies are designed to carry a particular product or range of products. If the product to be conveyed is not referred to in the scope of the standard or other technical documents or if the concentration, temperature or pressure limits are not within the quoted ranges, the hose manufacturer should be consulted.

Care should be taken to avoid stagnation of products, particularly solutions and emulsions, within the hose as the resultant settling may give concen-

trations exceeding the permissible limits which may lead to deterioration of the hose lining. To avoid this, it is recommended that, whenever possible, the hose be drained and rinsed after use.

In view of the serious consequences of failure, adequate precautions should be taken to minimize the effects of bursting of the hose or hose assembly.

3.6 Hoses for the conveyance of flammable products

In most countries, there are regulations pertaining to the storage and transport of flammable products, including liquid hydrocarbons (petrol, kerosene and diesel oil) and liquefied hydrocarbons (LPG). Where the regulations apply to hoses used in the charging or discharging operation, they should be strictly adhered to.

Hoses and hose assemblies should be subjected to regular examinations to establish their continued suitability for use, particularly in respect of electrical properties. It is recommended that, when not in use, the hose be drained.

When using hoses and hose assemblies to convey liquid hydrocarbons, it is essential that the aromatic hydrocarbon content is within the limits given in the hose specification.

3.7 Automotive hoses

Hoses and hose assemblies used on automobiles are exposed to, and should be made resistant to or protected from, hostile environments such as

- a) the conditions of their location: for example under the bonnet (hood), where they may come into contact with fuel oils, lubricating oils, battery acid, etc., be exposed to heat from the engine or be exposed to an ozone-enriched atmosphere;
- b) the conditions in which the vehicle may be required to operate, such as extremes of temperature and humidity or splashing with sand, mud, gravel, snow, ice, etc.;
- c) movements between parts of the vehicle to which the hoses or hose assemblies are connected, and vibration.

In the conditions given in a) and b) above, it is recommended that the hoses and hose assemblies be protected by shields wherever possible.

Where the installation involves severe bends or where the fixing points are in different planes, the use of moulded (shaped) hose should be considered. Under no circumstances should hoses be subjected to bend radii less than that specified in the hose standard. Care should be exercised to ensure

that tension is minimized, twisting avoided and that there is sufficient clearance between the hose and adjacent components. Where such clearance exists under static conditions, it should be established that the dynamic operating conditions of the vehicle do not subject the hoses to vibrations or movements that may bring them into contact with hot spots or rub them against adjacent parts. The length of the hose or hose assembly should be kept to the minimum required to satisfy these conditions and, wherever possible, hoses should be supported by a suitable clipping arrangement.

The following special points should also be considered:

Coolant hoses should be sufficiently flexible to ensure that the radiator connection is not subjected to undue stress. Brake hoses and hose assemblies should be of sufficient length to allow them to function satisfactorily without undue stress under extremes of operating conditions, taking into consideration:

- clearance from other components, especially at extremes of movement, such as full lock of the wheel;

movements in relation to the fixing points, taking into consideration the high and low positions due to wheel bounce and the rotational movement during changes in direction.

3.8 Hydraulic hoses

3.8.1 General

The hoses and hose assemblies referred to in this clause are those used in hydraulic and pneumatic fluid power systems. They may therefore be subjected to impulse pressures or flexing or a combination of both. They are generally supplied to the end user as assemblies, i.e. with suitable and correctly fitted end fittings, tailored to suit an established layout.

In addition to the recommendations contained in 2.2, special attention should be paid to cleanliness as contamination of the bore of the hose by particles may result in damage to the equipment to which the hose assemblies are fitted. It is essential that hoses and hose assemblies are protected during storage to prevent ingress of foreign bodies.

The basic application of hydraulic hose assemblies is to provide satisfactory fluid flow, usually at relatively high pressures, where flexible connections are required. When establishing proper hose lengths, consideration should be given to motion absorption, hose length changes due to pressure, and hose and machine tolerances. Figure 1 shows some of the

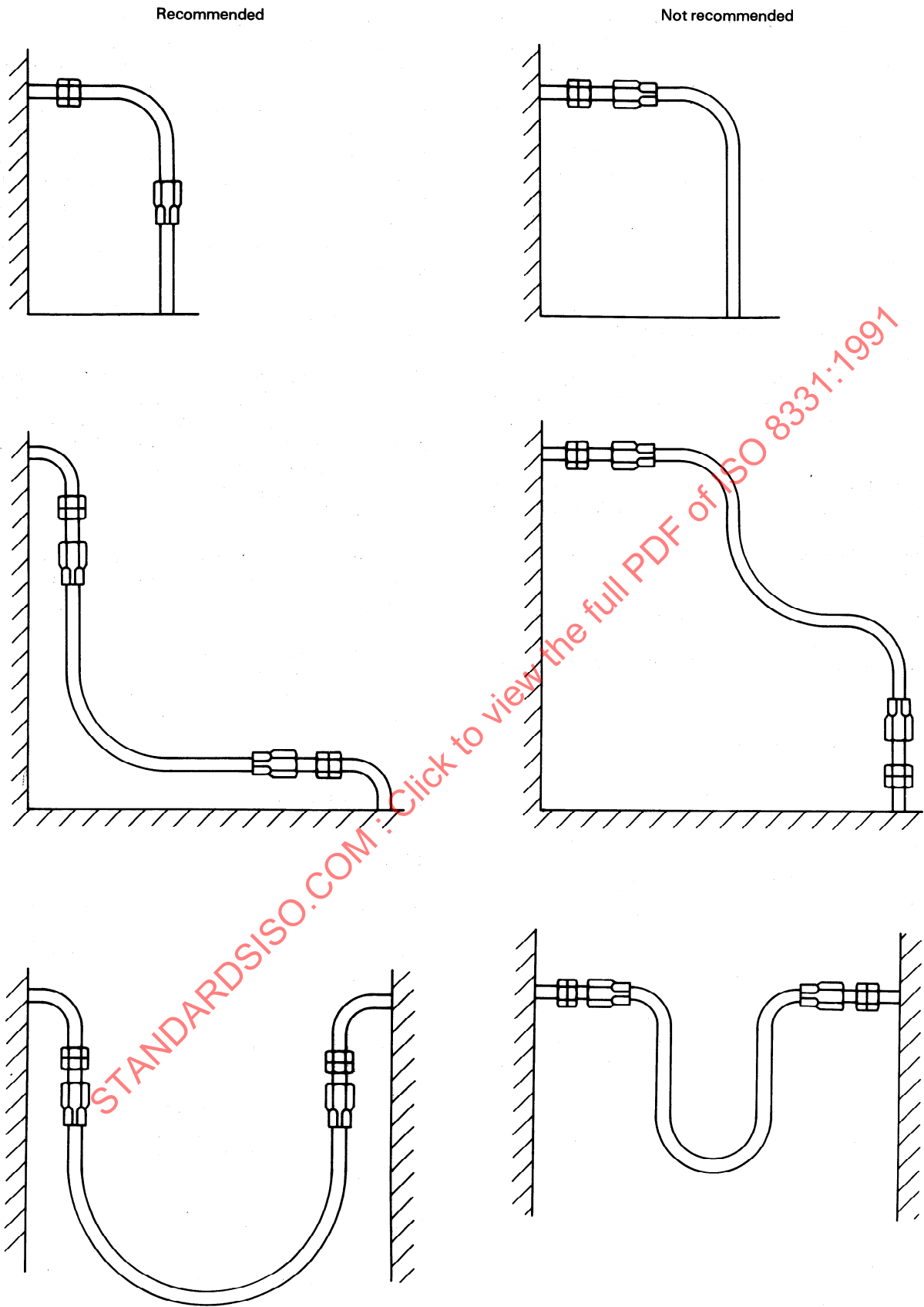


Figure 1 — Curved configurations for hydraulic hoses

recommended configurations and those which are to be avoided. When employing curved configurations, the portion of the hose adjacent to the coupling should be of sufficient length to accommodate the movement expected in that area.

3.8.2 Special points to be observed

3.8.2.1 Routing

Sufficient movement and clearance from adjacent parts should be provided to permit deflection of equipment under vibration and motion. The layout should be designed and fixed in such a way that the hose is not brought into contact with hot spots or rubbed against adjacent parts during operation.

3.8.2.2 Length

The length of the assembly should be adequate to provide sufficient movement without subjecting it to tension stress.

3.8.2.3 Curvature

The layout should be designed in such a way that the bend radii of the hose are as large as possible and at no time less than the minimum specified. It is important to consider any bending that may be induced during the normal working cycle of the equipment to which the assembly is fitted and to ensure that the requirements relating to curvature are observed.

Suitable support should be provided, wherever possible, to prevent the weight of the assembly causing additional bending and stress at the connections.

3.8.2.4 Vibration

Stresses attributable to vibration should be minimized and wherever possible avoided. When assemblies are attached to rigid parts, an adequate anchoring arrangement should be used as close as possible to the point of attachment.

3.8.2.5 Tensile stress

It is important to ensure that tensile stress is not induced in the hose due to movement of points on the equipment to which it is connected, or due to the shortening of the hose resulting from internal pressure, or due to any other cause.

3.8.2.6 Heat

Exposure to radiant heat, for example in the proximity of exhaust systems, should be avoided. In situations where the ambient temperature is high,

the hose should be protected by the use of heat shields or insulating materials.

3.8.2.7 Accessibility

Hoses and hose assemblies should be located at easily accessible points to facilitate their installation and maintenance.

3.8.2.8 Preparation for installation

Before installing a hose or hose assembly, it should be checked to ensure that the bore is clean and free from blockages (for example, protective end caps) and that the faces of the couplings are free from foreign bodies, burrs and flash. Surface defects, especially on taper and conical fittings, will give rise to leaks.

3.8.2.9 Installation

When installing a hose or hose assembly, it is essential to ensure that it is not twisted. (See figure 2.)

A hose or hose assembly should be allowed to take up its natural position by loosely attaching each end to its fixing point. Freedom from twist should be established and the joint made tight. When specific torque loads are stipulated for fittings or clips they should not be exceeded.

3.8.2.10 Repairs

The repair of hydraulic hoses is deprecated in view of the high pressures at which this type of hose is designed to operate and the possibility of injury attributable to the effects of failure, hence the need for strict controls when making the assembly, i.e. the preparation of the end of the hose, the use of the correct type of end fitting and the need to follow the appropriate instruction (dependent upon the type of fitting used).

3.9 Fire-fighting hoses

3.9.1 General

The hoses and hose assemblies referred to in this clause are those lay-flat and conventional flexible hoses used in fire-fighting applications using water or foam solutions.

Hoses are manufactured for the differing environments they may be required to operate in and care should be taken to ensure that the correct type is used, i.e. domestic, industrial, landbased, shipborne, etc.

Consideration should also be given to the working pressure of the system, the possibility of contact with aggressive substances and burning embers/hot

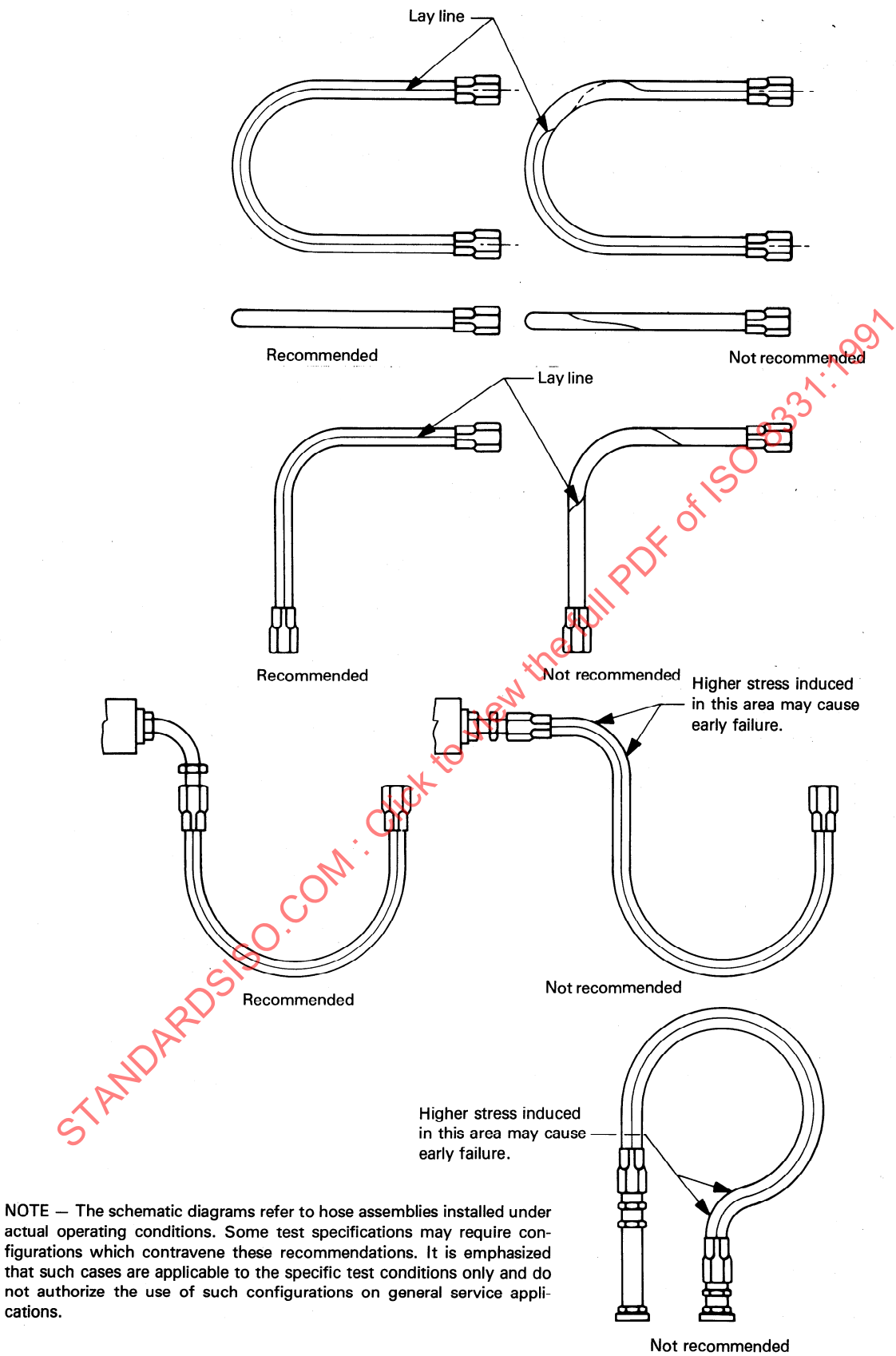


Figure 2 — Installation of hydraulic hose assemblies

surfaces. Failure to establish the end-use conditions could lead to premature failure of the hose.

Where there are requirements to comply with, laid down in statutory regulations or contractual standards or specifications, they should be strictly observed.

3.9.2 Special points to be observed

3.9.2.1 Storage

Prior to use, hoses and hose assemblies should be stored in a dry, well-ventilated place.

3.9.2.2 Installation

When a hose or hose assembly is installed, either in a fixed position or on a vehicle, it should be positioned in such a way as to ensure the circulation of air and prevent contact with other components that may result in abrasion, i.e. sides of lockers if carried on a fire-fighting vehicle.

To minimize the risk of permanent deformation when a hose is coiled around a drum, it should be periodically unwound and rewound in the opposite direction.

NOTE 4 This does not apply to hoses vulcanized on coil and pre-folded, respectively.

Lay-flat hoses may be stored in a flaked condition.

To prevent damage and permanent deformation, they should be periodically unfolded and refolded such that the folds occur in different positions.

3.9.2.3 Use

When in use, precautions should be taken to avoid damage by crushing caused by being run over by vehicles, as this may result in a restriction in the flow rate or pressure. When hoses are uncoiled or unfolded along the ground, they should not be dragged over rough surfaces or sharp objects nor should they be pulled with excessive force to remove kinks or loops. Protective coverings (sleeves) should be used where hoses may come into contact with abrasive surfaces, particularly close to the pumping point.

3.9.2.4 Application of pressure

Before pressure is applied, hoses and hose assemblies should be as straight as possible and free from kinks/loops.

Nozzles and valves should be opened and closed slowly to prevent surges and water hammer.

3.9.2.5 Maintenance

After use, the hoses and hose assemblies should be drained, cleaned (both internally and externally) and dried, after which they should be examined for defects.

If the hose has been used in a situation where it may have been in contact with chemical products or if it may have been subjected to severe stresses, it is recommended that it be hydrostatically tested to ensure suitability for further use. Unless there are statutory requirements or regulations, it is recommended that the test be carried out in accordance with ISO 1402.

Irrespective of whether or not they have been used, hoses and hose assemblies should be inspected and tested at least once a year.

3.10 Oil industry hoses and hose assemblies

3.10.1 General

The hoses and hose assemblies referred to in this clause are those used in the oil industry for the bulk transfer of liquid petroleum products.

They may be used for ship to ship or ship to shore transfer where they may be submerged, floating or suspended. Hoses and hose assemblies used for bulk delivery on land by either road or rail tanker are covered by the general recommendations in section 2 with the additional recommendations of 3.6.

Generally, the hoses are of bore sizes greater than those used in general industrial applications. Whilst the general recommendations of section 2 apply, because of their bulk and the situations in which they are used, there are special needs in respect of storage, handling and repair.

Reference should also be made to the following documents:

- a) OCIMF guide;
- b) Buoy Mooring Forum — Guide for handling, storage inspecting and testing of hoses on site;
- c) relevant national, international, manufacturers' and oil companies' specifications.

3.10.2 Special points to be observed

3.10.2.1 Storage

When storage under the recommended conditions is not possible, i.e. they are stored outside, care

should be taken to protect hoses and hose assemblies from exposure to atmospheric attack.

Large-bore hoses supplied in straight lengths, particularly those with moulded-in couplings, should be adequately supported at all times with the end caps maintained at all times. (See figure 3.).

3.10.2.2 Handling

Large-bore hoses and hose assemblies supplied in straight lengths should be adequately supported

when moved, especially when they are lifted. (See figure 4.)

3.10.2.3 Repairs

Whilst the repair of hoses, particularly of the carcass, is not recommended (see 2.3.17) because of the size and the high initial cost, minor repairs may be undertaken. When this is permissible (statutory regulations and insurers' requirements should be observed), the hose manufacturer's instructions should be adhered to. After repair, the hose or hose assembly should be retested, including electrical testing if applicable.

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